

1 7. The biopharmaceutical product cryopreservation system of
2 claim 6, wherein the biological cell cryoprotectants comprise penetrating
3 or nonpenetrating cryoprotectants.

1 8. The biopharmaceutical product cryopreservation system of
2 claim 6, wherein the vitrifying agents or components of
3 biopharmaceutical drug formulations comprise surfactants, PEG,
4 carbohydrates, polyols, amino acids or proteins other than the
5 biopharmaceutical product.

1 9. The biopharmaceutical product cryopreservation system of
2 claim 1, wherein the biopharmaceutical product cryopreservation system
3 comprises more than one cryopreservation vial.

1 10. The biopharmaceutical product cryopreservation system of
2 claim 1, wherein the cryopreservation vial comprises media, and the
3 media comprises the biopharmaceutical product.

1 11. The biopharmaceutical product cryopreservation system of
2 claim 10, wherein the cryopreservation fluid and the media are
3 substantially identical in composition.

1 12. The biopharmaceutical product cryopreservation system of
2 claim 10, wherein a thermal conductivity and/or a specific heat of the
3 cryopreservation vial are substantially similar to those of the media or
4 the cryopreservation fluid.

1 13. A method of cryopreserving biopharmaceutical products
2 comprising
3 providing a cryopreservation compartment;
4 locating a biopharmaceutical product cryopreservation vial within
5 the cryopreservation compartment, wherein the biopharmaceutical
6 product cryopreservation vial comprises a body that comprises an
7 oblong cross-section defining proximal and distal ends of the body, and
8 at least one nucleating structure, coupled to a distal end of the body, and
9 the body comprising a cryogenically stable material that is compatible
10 with biopharmaceutical products.
11 locating a cryopreservation fluid in a space outside of the
12 cryopreservation vial but within the cryopreservation compartment; and
13 removing heat from the cryopreservation compartment, thereby
14 freezing the cryopreservation fluid.

1 14. The method of claim 13, wherein the cryopreservation vial
2 comprises media, and the media comprises the biopharmaceutical
3 product.

1 15. The method of claim 13, wherein the heat is removed at a
2 rate that substantially maintains a temperature driving force within the
3 cryopreservation compartment so as to promote a substantially constant
4 freezing front velocity within the cryopreservation compartment.

1 16. The method of claim 13, wherein the heat is removed at a
2 rate that varies so as to vary an interdendritic spacing at an edge of, or
3 within, a solid front, wherein the solid front is located within the
4 cryopreservation compartment.

1 17. The method of claim 13, wherein the cryopreservation
2 compartment comprises one or more cooling surfaces.

1 18. The method of claim 17, wherein the one or more cooling
2 surfaces comprise one or more internal surfaces of the cryopreservation
3 compartment.

1 19. The method of claim 17, wherein the one or more cooling
2 surfaces comprise two or more cooling surfaces spaced apart from one
3 another.

1 20. The method of claim 19, wherein a distance between two
2 or more cooling surfaces spaced apart from one another ranges from
3 about 0.1 mm to about 1500 mm.

1 21. The method of claim 13, wherein the cryopreservation fluid
2 comprises biological cell cryoprotectants, vitrifying agents, components
3 of biopharmaceutical drug formulations, distilled water, buffers,
4 carbohydrates in water, salts and carbohydrates in water, PEG in water,
5 or detergent/surfactant in
6 water.

1 22. The method of claim 21, wherein the biological cell
2 cryoprotectants comprise penetrating or nonpenetrating cryoprotectants.

1 23. The method of claim 21, wherein the vitrifying agents or
2 components of biopharmaceutical drug formulations comprise
3 surfactants, PEG, carbohydrates, polyols, amino acids or proteins other
4 than the biopharmaceutical product.

1 24. The method of claim 13, wherein the biopharmaceutical
2 product cryopreservation system comprises more than one
3 cryopreservation vial.

1 25. The method of claim 13, wherein the cryopreservation vial
2 comprises media, and the media comprises the biopharmaceutical
3 product.

1 26. The method of claim 25, wherein the cryopreservation fluid
2 and the media are substantially identical in composition.

1 27. A biopharmaceutical product cryopreservation vial
2 comprising:
3 a body that comprises an oblong cross-section defining proximal
4 and distal ends of the body,
5 at least one nucleating structure, coupled to a distal end of the
6 body, and
7 the body comprising a cryogenically stable material that is
8 compatible with biopharmaceutical products.

1 28. The biopharmaceutical product cryopreservation vial of
2 claim 27, wherein the cryopreservation vial comprises media, and the
3 media comprises a biopharmaceutical product.

1 29. The biopharmaceutical product cryopreservation vial of
2 claim 27, wherein the cryogenically stable material that is compatible
3 with biopharmaceutical products comprises a polymer.

1 30. The biopharmaceutical product cryopreservation vial of
2 claim 27, wherein the polymer comprises polytetrafluoroethylene,
3 polystyrene, polyethylene or polypropylene.

1 31. The biopharmaceutical product cryopreservation vial of
2 claim 27, wherein surface treatments have been applied to a surface of
3 the biopharmaceutical product cryopreservation vial.

1 39. The biopharmaceutical product cryopreservation vial of
2 claim 38, wherein internal surface tips of the extensions are spaced
3 apart from about 0.001 mm to about 1 mm.

1 40. The biopharmaceutical product cryopreservation vial of
2 claim 39, wherein internal surface tips of the extensions are spaced
3 apart from about 0.04 mm to about 0.5 mm.